

Table A1. Characteristics of included studies

Study	Study Design (Level of Evidence)	Study Location		Sport Type	Competition Level	Sample Size, n, GIRD/Control	Sex, n, M:F	Age, y, mean	Outcome Measure
Almeida et al, 2013 ¹	Case-control (level 3)	Brazil		Handball	Recreational	30/27	28:29	20.5	Shoulder pain
Dines et al, 2009 ⁵	Case-control (level 3)	USA		Baseball	Professional, college, high school	29/29	58:0	21.17	UCL injury
Garrison et al, 2012 ⁷	Case-control (level 3)	USA		Baseball	College, high school	30/30	60:0	18.2	UCL injury
Heyworth et al, 2016 ⁸	Case series (level 4)	USA		Baseball/tennis	Youth	28/67	93:2	13.1	Shoulder injury
Lee et al, 2015 ¹⁰	Case-control (level 3)	Korea		Baseball	High school	12/44	56:0	16.92	Shoulder pain
Moreno-Perez et al, 2015 ¹²	Case-control (level 3)	Spain, Canada		Tennis	Professional	19/28	47:0	25.6	Shoulder pain
Myers et al, 2006 ¹³	Case-control (level 3)	USA		Baseball	Professional, college	11/11	22:0	22.1	Shoulder injury
Nakagawa et al, 2012 ¹⁴	Case series (level 4)	Japan		Baseball	NR	50/11	61:0	NR	Shoulder injury
Reeser et al, 2010 ¹⁷	Cross-sectional (level 4)	USA		Volleyball	College	242/180	286:136	21.3	Shoulder pain
Scher et al, 2010 ¹⁸	Cross-sectional (level 4)	USA		Baseball	Professional	23/34	57:0	26.3	Shoulder injury
Shanley et al, 2015 ¹⁹	Prospective cohort (level 2)	USA		Baseball	Youth	68/47	115:0	14.9	Shoulder and elbow injury
Shanley et al, 2011 ²⁰	Prospective cohort (level 2)	USA		Softball/baseball	High school	27/219	143:103	15.7	Shoulder and elbow injury
Tonin et al, 2013 ²¹	Cross-sectional (level 4)	Slovenia		Volleyball/handball	Top national	14/22	0:36	NR	Shoulder injury
Tyler et al, 2014 ²²	Case-control (level 3)	USA		Baseball	High school	28/73	101:0	NR	Shoulder and elbow injury
Wilk et al, 2011 ²⁶	Case series (level 4)	USA		Baseball	Professional	22/137	170:0	25.6	Shoulder injury
Wilk et al, 2014 ²⁴	Prospective cohort (level 2)	USA		Baseball	Professional	37/259	296:0	25	Elbow Injury
Wilk et al, 2015 ²⁵	Prospective cohort (level 2)	USA		Baseball	Professional	51/245	296:0	25	
Totals	USA: 1			Baseball: 13	Youth:2				
	Slovenia: 1			Handball: 2	High School: 5				
	Korea:			Softball: 1	College: 4				
	Japan: 1			Tennis: 2	Top National: 1	721/1463	1189:306		
	Spain: 1			Volleyball: 2	Professional: 7			Shoulder: 14	
	Canada: 1				Recreational: 1			Elbow: 6	
	Brazil: 1				NR:1				

F, female; GIRD, glenohumeral internal rotation deficit; M, male; NR, not recorded; UCL, ulnar collateral ligament.

TABLE A2. Specific outcome measures reported for each individual study

Study	GIRD	Total Range of Motion	Total Rotational Loss	Total External Rotation	External Rotational Gain
Almeida et al, 2013 ¹	X	X	X	X	X
Dines et al, 2009 ⁹		X		X	X
Garrison et al, 2012 ⁷	X	X	X	X	
Heyworth et al, 2016 ⁸					
Lee et al, 2015 ¹⁰		X	X	X	X
Moreno-Perez et al, 2015 ¹²	X	X	X	X	X
Myers et al, 2006 ¹³	X	X	X	X	X
Nakagawa et al, 2012 ¹⁴					
Reeser et al, 2010 ¹⁷					
Scher et al, 2010 ¹⁸	X				
Shanley et al, 2015 ¹⁹					
Shanley et al, 2011 ²⁰	X	X	X	X	X
Tonin et al, 2013 ²¹				X	
Tyler et al, 2014 ²²					
Wilk et al, 2011 ²⁶	X				
Wilk et al, 2014 ²⁴					
Wilk et al, 2015 ²⁵					

GIRD, glenohumeral internal rotation deficit.

TABLE A3. Quality assessment of included studies using GRADE criteria

Study	Patients, N	Design	Limitations	Inconsistency	Indirect	Imprecision	Publication Bias	Quality
Almeida et al, 2013 ¹	57	Observational	Serious	No	No	No	No	Low
Dines et al, 2009 ⁵	58	Observational	Serious	Yes	Yes	No	No	Low
Garrison et al, 2012 ⁷	60	Observational	Serious	No	No	No	No	Low
Heyworth et al, 2016 ⁸	95	Observational	Serious	No	Yes	Yes	No	Very Low
Lee et al, 2015 ¹⁰	56	Observational	Serious	No	Yes	No	No	Very Low
Moreno-Perez et al, 2015 ¹²	47	Observational	Serious	No	No	No	No	Low
Myers et al, 2006 ¹³	22	Observational	Serious	No	No	No	No	Low
Nakagawa et al, 2012 ¹⁴	61	Observational	Serious	No	Yes	Yes	No	Very Low
Reeser et al, 2010 ¹⁷	422	Observational	Serious	Yes	Yes	Yes	No	Very Low
Scher et al, 2010 ¹⁸	57	Observational	Serious	No	No	No	No	Low
Shanley et al, 2015 ¹⁹	115	Observational	Serious	No	Yes	Yes	No	Very Low
Shanley et al, 2011 ²⁰	246	Observational	Serious	No	No	No	No	Low
Tonin et al, 2013 ²¹	36	Observational	Serious	Yes	Yes	Yes	No	Very Low
Tyler et al, 2014 ²²	101	Observational	Serious	No	Yes	Yes	No	Very Low
Wilk et al, 2011 ²⁶	159	Observational	Serious	No	No	No	No	Low
Wilk et al, 2014 ²⁴	296	Observational	Serious	No	Yes	No	No	Low
Wilk et al, 2015 ²⁵	296	Observational	Serious	No	Yes	No	No	Low

TABLE A4. Results of secondary outcomes: total range of motion, total rotational loss, total external rotation, external rotational gain

Outcome	Study	Injury Mean, deg	Total, n	No Injury Mean, deg	Total, n	Weight	Mean Difference [95% CI]	<i>I</i> ² (%)	P Value
<u>Total Range of Motion</u>									
	Almeida et al, 2013 ¹	141.61	30	141.8	27	12.9%	-0.19 [-9.13, 8.75]		
	Dines et al, 2009 ⁵	133.45	29	143.1	29	15.6%	-9.65 [-17.55, -1.75]		
	Garrison et al, 2012 ⁷	143.13	30	140.6	30	24.6%	2.53 [-2.99, 8.05]		
	Lee et al, 2015 ¹⁰	147.46	12	150.55	44	9.1%	-3.09 [-14.22, 8.04]		
	Moreno-Perez et al, 2015 ¹²	131.5	19	139.4	28	13.0%	-7.90 [-16.81, 1.01]		
	Myers et al, 2006 ¹³	168.3	11	172.2	11	12.0%	-3.90 [-13.28, 5.48]		
	Shanley et al, 2011 ²⁰	179.1	27	181.4	219	12.8%	-2.30 [-11.30, 6.70]		
	Total		158		388	100.0%	-2.97 [-6.64, 0.70]	26	0.11
<u>Total Rotational Loss</u>									
	Almeida et al, 2013 ¹	4.4	30	2.9	27	12.2%	1.50 [-5.73, 8.73]		
	Garrison et al, 2012 ⁷	6.67	30	0.93	30	20.1%	5.74 [0.22, 11.26]		
	Lee et al, 2015 ¹⁰	3.21	12	3.66	44	23.2%	-0.45 [-5.55, 4.65]		
	Moreno-Perez et al, 2015 ¹²	4.6	19	7.1	28	16.0%	-2.50 [-8.75, 3.75]		
	Myers et al, 2006 ¹³	11.4	11	6	11	7.2%	5.40 [-4.10, 14.90]		
	Shanley et al, 2011 ²⁰	4.7	27	1.3	219	21.2%	3.40 [-1.96, 8.76]		
	Total		129		359	100.0%	1.95 [-0.65, 4.55]	8	0.14
<u>Total External Rotation</u>									
	Almeida et al, 2013 ¹	108	30	102.4	27	14.7%	5.60 [0.28, 10.92]		
	Dines et al, 2009 ⁵	104.45	29	104.76	29	14.7%	-0.31 [-5.60, 4.98]		
	Garrison et al, 2012 ⁷	113.3	30	119.7	30	12.5%	-6.40 [-12.93, 0.13]		
	Lee et al, 2015 ¹⁰	106.92	12	108.57	44	11.5%	-1.65 [-8.78, 5.48]		
	Moreno-Perez et al, 2015 ¹²	90.8	19	90.3	28	14.5%	0.50 [-4.88, 5.88]		
	Myers et al, 2006 ¹³	125.8	11	121.1	11	8.5%	4.70 [-4.59, 13.99]		
	Shanley et al, 2011 ²⁰	122.4	27	125.2	219	11.4%	-2.80 [-9.95, 4.35]		
	Tonin et al, 2013 ²¹	120	14	129	22	12.2%	-9.00 [-15.70, -2.30]		
	Total		172		410	100.0%	-1.15 [-4.59, 2.29]	57	0.51
<u>External Rotational Gain</u>									
	Almeida, et al, 2013 ¹	10.3	30	4.4	27	16.5%	5.90 [0.84, 10.96]		
	Dines et al, 2009 ⁵	10.27	29	11.83	29	14.7%	-1.56 [-6.92, 3.80]		
	Lee et al, 2015 ¹⁰	11.25	12	8.5	44	7.5%	2.75 [-4.76, 10.26]		
	Moreno-Perez et al, 2015 ¹²	7.2	19	5.6	28	42.4%	1.60 [-1.56, 4.76]		
	Myers et al, 2006 ¹³	8.3	11	5.1	11	10.8%	3.20 [-3.07, 9.47]		
	Shanley et al, 2011 ²⁰	5.3	27	5.8	219	8.0%	-0.50 [-7.77, 6.77]		
	Total		128		358	100.0%	1.93 [-0.12, 3.99]	0	0.07